UNITED STATES DEPARTMENT OF AGRICULTURE

U.S. SOIL CONSERVATION SERVICE

MINUTES

EIGHTEENTH ANNUAL MEETING

COLUMBIA RIVER BASIN WATER

FORECAST COMMITTEE

Presiding Chairman
Murray G. Walker, Supervisor
Division of Water Resources
State of Washington
Olympia, Wash.

General Co-Chairmen

M. W. Nelson, Snow Survey Leader
Soil Conservation Service
Boise, Idaho

Anthony J. Polos, Hydrologist in Charge
River Forecast Center, U. S. Weather Bureau
Portland, Oregon

Meeting Held
at
Portland, Oregon

April 13, 1955

ATTENDANCE
EIGHTEENTH ANNUAL MEETING
COLUMBIA RIVER BASIN WATER FORECAST COMMITTEE
APRIL 13, 1955

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EIGHTEENTH ANNUAL MEETING
COLUMBIA RIVER BASIN WATER FORECAST COMMITTEE
Multnomah Hotel
Portland, Oregon
April 13, 1955

The joint meeting of the Western Snow Conference and the Columbia River Basin Water Forecast Committee was called to order at 9:00 A.M. by Walter E. Johnson, of the Washington Water Power Company, Spokane, Wash., General Chairman. Opening remarks for the Forecast Committee were made by M. W. Nelson, Snow Survey Leader for the Columbia Basin, Soil Conservation Service, Boise, Idaho. He turned the meeting over to Murray G. Walker, Supervisor, Division of Water Resources, State of Washington, Olympia, Wash, who as Presiding Chairman, conducted the meeting as follows:

DISCUSSION OF 1954 RUNOFF

Accuracy of 1954 Runoff Forecasts in British Columbia, by J. H. Doughty-Davies, Hydraulic Engineer, Water Rights Branch, Department of Lands and Forests, Victoria, B.C.

In 1954 the snow pack in British Columbia was the greatest on record. It was particularly heavy in the Columbia and Kootenay river basins. Further, the water derived from the melting of this snow was augmented by the spring rains. In spite of the potential flood hazard, no extremely high flood peaks occurred. The cool weather continued from the spring into summer and controlled the runoff most effectively.

While the runoff forecasts were higher than any on record, the actual runoff exceeded the forecast in most of the cases. This difference between actual and forecast was generally small and it is believed that the accuracy of the 1954 forecasts was extremely good.

In 60% of the forecasts, the difference between forecast and the actual runoff was less than 10%; and in 87% of the forecasts, the difference was less than 15%. It is therefore concluded that the forecasts for 1954 supplied accurate and valuable information to those interested in it.

The following table lists the forecasts made and supplies a comparison with the actual runoffs.

STATIONS FORECAST (1) April to August (2) April to July		FORECAST 1000's AC.FT.	ACTUAL 1000's AC.FT.	PER CENT DIFFERENCE %
Columbia at Nicholson	(1)	2,790	2,852	- 2.2
Columbia at Revelstoke	(1)	19,100	20,742	- 7.9
Columbia at Birchbank	(1)	49,950	48,389	+ 3.2
Kootenay at Wardner	(1)	5,650	5,870	- 3.8
Elk at Stanley Park	(1)	1,796	1,767	+ 1.6

Table Continued

STATIONS FORECAST (1) April to August (2) April to July		FORECAST 1000's AC.FT.	ACTUAL 1000's AC.FT.	PER CENT DIFFERENCE %
Lardeau at Gerrard	(1)	675	771	- 12.4
Duncan at Howser	(1)	2,150	2,259	- 5.5
Slocan at Crescent Valley	(1)	2,117	2,240	- 5.5
Inflow to Kootenay Lake	(1)	21,500	22,850	- 5.9
Inflow to Okanagan Lake	(2)	337	432	- 22.0
North Thompson at Barriere	(2)	7,690	8,405	- 8.5
Inflow to Stave	(2)	1,040	1,242	- 16.2
Capilano at North Vancouver	(2)	192	215	- 10.7
Inflow to Powell Lake	(2)	1,040	1,196	- 13.0
Inflow to Lois Lake	(2)	266	246	+ 12.3

Outcome of 1954 Volume Forecasts, by W. D. Simons, U. S. Geological Survey, Tacoma, Washington.

This is the first time this phase of the forecasting problem has been presented at the Columbia River Basin Water Forecast Committee meetings. It is being done this time in the interest presenting general information on the accuracy of the volume forecasts. This is not a complete check of all the forecasts made last year but rather a partial check covering about one half of the forecasts in all parts of the Columbia River basin above Bonneville Dam. The forecasts were tabulated from Water Supply Forecasts for Western United States, April 1, 1954, and the minutes of meeting of Columbia River Basin Water Forecast Committee, April 12, 1954. The runoff figures have been furnished by the district offices and the Current Records Center of the Surface Water Branch, Geological Survey. In most instances these are based upon recorder charts and other basic data and very few deviations from the published figures may be expected. The forecasts by the Weather Bureau and Soil Conservation Service are for observed runoff or for observed runoff adjusted for the effects of certain upstream reservoirs. In these cases, adjustments have been made accordingly.

The Weather Bureau prepared forecasts at about 115 locations in the Columbia River basin above Bonneville Dam. These forecasts are for the water year runoff in all instances except two. In order to reduce these values to April to September forecasts, the actual flow for the period October through March was subtracted from the annual forecasts. The following tabulation gives a summary of results of the Weather Bureau forecasts verified in this study.

Forecasts		Average error of residual forecasts	Number of forecasts with errors of:			
made	verified		0-9.9%	10-19.9%	20-29.96	above 30%
115	46	9.6% *	26	13	4	3

*Errors for Salmon Falls Creek near San Jacinto, Nev.; Big Wood River near Richfield, Idaho; and Owyhee Reservoir Net Inflow not included.

The Soil Conservation Service prepared forecasts for 119 points in the Columbia River basin above Bonneville Dam. These forecasts were for runoff during the April to September period or for shorter periods such as April to June or July. The following tabulation summarizes the results of the Soil Conservation Service forecasts verified in this study.

	Forecasts made	Forecasts verified	average error	number of forecasts with errors of: 0-9.9%	10-19.9%	20-29.9	above 30%
April-Sept.	89	45	9.5%*	27	8	6	4
April-June or July	30	12	11.0	4	3	2	3

*Errors for Salmon Falls Creek near San Jacinto, Nev.; Big Wood River near Richfield, Idaho; and Owyhee Reservoir Net Inflow not included.

Incident to the preparation of flood-peak forecasts on the main stem and various tributaries of the Columbia River, the Corps of Engineers prepares April to September volume forecasts. These volume forecasts have incorporated in them the effects of contemplated storage and flood regulation for certain upstream projects. As such these forecasts are for observed runoff. The following tabulation gives a summary of the results of the Corps of Engineers forecasts verified in this study.

Forecasts made	Forecasts verified	Average error	Number of forecasts with errors of: 0-9.9%	10-19.9%	20-29.9%
13	13	9.0%	8	3	2

In addition to the forecasts presented by the government agencies two additional forecasts were presented by Washington Water Power Co. One was for the April to September runoff of the Spokane River at Post Falls, Idaho, which resulted in error of +18% and the other was for the April to July inflow to Chelan Lake which resulted in an error of +7%.

In the most part the forecasts presented at last year's meeting were quite good. This is especially true in the portion of the Columbia River basin above the Snake River. The least accurate forecasts were in the south-central Snake basin centering around the Owyhee and Big Wood Rivers and Salmon Falls Creek.

The following table presents pertinent data for individual forecasts which were verified in this study.

1954 FORECASTED AND OBSERVED RUNOFF, COLUMBIA RIVER BASIN

All runoff values in 1,000 A.F.

Station	Weather Bureau 1/ April-Sept. Fore	Weather Bureau April-Sept. Obs.	Weather Bureau Fore. / Obs.	Soil Conservation Service April-Sept. Fore	Soil Conservation Service April-Sept. Obs.	Soil Conservation Service Fore. / Obs.	Soil Conservation Service April-July Fore	Soil Conservation Service April-July Obs.	Soil Conservation Service Fore. / Obs.	Corps of Engineers April-Sept. Fore.	Corps of Engineers April-Sept. Obs.	Corps of Engineers Fore. / Obs.
Kootenay R. at Leonia, Ida.	11,700	12,320	.95	11,400	12,320	.93				11,500	12,320	.93
Columbia R. at Birchbank, B.C.	47,900	54,200	.88	52,800	54,200	.97				47,000	54,200	.88
Blackfoot R. at Bonner, Mont.				1,070	1,133	.94						
Clark Fork above Missoula, Mont.	1,960	1,737	1.13	1,840	1,737	1.06						
Bitterroot R. nr. Darby, Mont.				622	515	1.21						
Clark Fork at St. Regis, Mont.	4,760	4,885	.97	4,630	4,885	.95						
Flathead R. nr Columbia Falls, Mont.				2,460	2,741	.90						
M. F. Flathead R. nr West Glacier, M.				2,230	2,446	.91						
S.F. Flathead R. nr. Columbia Falls	2,730	2,826	.96	2,710	2,826	.96						
Flathead R. at Columbia Falls, Mont.	7,480	8,267	.90	7,540	8,267	.91						
Flathead R. near Polson, Mont.	8,820	9,708	.91	8,750	9,708	.90						
Pend Oreille R. at "Z" Canyon, Wash.	18,500	19,570	.94	18,100	19,570	.92				19,000	15,800	1.20
Kettle R. nr Laurier, Wash.	1,850	2,229	.83									
St. Joe R. nr. Calder, Ida.	1,560	1,640	.95				1,570	1,549	1.01			
Spokane R. at Post Falls, Ida.	3,570	3,617	.99	3,630	3,617	1.00						
Spokane R. at Spokane, Wash.	3,860	3,782	1.02							3,600	3,690	.98
Columbia R. at Grand Coulee, Wash.	76,400	83,800	.91	79,800	83,800	.95						
Okanogan R. nr. Tonasket, Wash.	2,470	2,381	1.04	2,760	2,381	1.16		"		1,700	2,381	.71
Methow R. at Twisp, Wash.	1,280	1,222	1.05	1,380	1,222	1.13						
Chelan R. at Chelan, Wash.	1,400	1,577	.89	1,620	1,577	1.03	1,440	1,305	1.10			
Wenatchee R. at Plain, Wash.	1,450	1,723	.84	1,640	1,723	.95						
Columbia R. nr Trinidad, Wash.	84,500	90,700	.93	88,700	90,700	.98				74,000	82,260	.90
Yakima R. nr Martin, Wash.	150	195.6	.76	181	195.6	.92						
Kachees R. nr Easton, Wash.	136	176.6	.77	158	176.6	.89						
Cle Elum R nr Roslyn, Wash.	527	638.7	.82	581	638.7	.91						
Bumping R. nr Nile, Wash.	189	198.7	.95	174	198.7	.88						
Yakima R at Kiona, Wash.										1,800	1,750	1.03
Snake R. at Moran, Wyo.	877	1,010	.87	970	1,010	.96						
Snake R. nr Heise, Ida.	4,360	4,001	1.09	4,220	4,001	1.05				4,300	4,090	1.05
Teton R at St. Anthony, Ida.	363	357.5	1.02	432	357.5	1.21						

1954 FORECASTED AND OBSERVED RUNOFF, COLUMBIA RIVER BASIN

All runoff values in 1,000 A.F.

Station	Weather Bureau [1] April-Sept. Fore.	Weather Bureau April-Sept. Obs.	Weather Bureau Fore./Obs.	Soil Conservation Service April-Sept. Fore.	Soil Conservation Service April-Sept. Obs.	Soil Conservation Service Fore./Obs.	Soil Conservation Service April-July Fore	Soil Conservation Service April-July Obs.	Soil Conservation Service Fore./Obs.	Corps of Engineers April-Sept. Fore.	Corps of Engineers April-Sept. Obs.	Corps of Engineers Fore./Obs.
Henrys Fork nr Rexburg, Ida.	637	608	1.05	802	608	1.32						
Oakley Reservoir Inflow, Ida.	12.2	10.6	1.15									
Salmon Falls Cr. nr San Jacinto, Nev.	59.3	23.5	2.52				60	21.6	2.78			
Big Wood River nr Richfield, Ida.	284	207.4	1.37	334	207.4	1.61	320	196	1.63			
Owyhee Reservoir Net Inflow 2/	219	71	3.08	240	71	3.38	3/ 200	130	1.54			
Boise R. nr Twin Springs, Ida.	731	809	.90				755	754	1.00			
Boise R. above Diversion Dam, Ida.	1,470	1,611	.91	1,620	1,611	1.01						
Malheur R. nr Drewsey, Ore.	47.8	44.4	1.08	54	44.4	1.22						
Payette R. nr Horseshoe Bend, Ida.	1,890	2,063	.92	2,030	2,063	.98						
Weiser R. nr Weiser, Ida.	296	385	.77	419	385	1.09						
Snake R. at Weiser, Ida.	7,495	6,286	1.19	7,910	6,286	1.26						
Powder R. nr Baker (Salisbury) Ore.	45.1	39.9	1.13	50	39.9	1.25	48	38.4	1.25			
Imnaha R. at Imnaha, Ore.	275	253.7	1.08	290	253.7	1.14						
Salmon R. nr Challis, Ida.	843	968.6	.87				890	848.5	1.05			
Salmon R. at Whitebird, Ida.	6,910	6,786	1.02	7,200	6,786	1.06				7,400	6,786	1.09
Grande Ronde R. at La Grande, Ore.	156	122	1.27	126	122	1.03						
Clearwater R. at Spalding, Ida.	9,370	9,356	1.00	9,800	9,356	1.05				9,500	9,356	1.01
Snake R. nr. Clarkston, Wash.	26,600	24,680	1.08							27,500	24,680	1.11
S. F. Walla Walla R. nr Milton, Ore.	63.7	66.4	.96	62	66.4	.93	49	52.6	.93			
White R. below Tygh Valley, Ore.	180	176.3	1.02	156	176.3	.88	140	157.7	.89			
Deschutes R. at Moody, Ore.										2,000	2,175	.92
Columbia R. nr The Dalles, Ore.	115,500	119,200	.97	120,000	117,100	1.02	4/ 80,000	69,100	1.16	110,000	111,000	.99
Hood R. and conduit nr Hood R., Ore.				318	399	.80	260	343	.76			

1/ Residual Forecast
2/ From U.S.B.R. records of inflow
3/ March-July
4/ April-June

U.S.G.S. Tacoma, Wash.

CONDITIONS AFFECTING RUNOFF

Precipitation Summary for the Columbia Basin Since October 1, 1954, by David J. Bauman, U. S. Weather Bureau, Portland, Oregon.

Precipitation during the fall months of the 1955 water year (September through November) was generally below to well below the average of the 10-year period (1943-1952). In the Snake, John Day and Deschutes basins, fall precipitation was generally near 50 per cent of average; however, 3-month totals as low as 30 per cent of average were prevalent in the Owyhee and left bank Snake Basins in southwestern Idaho. In the Basin north of the mouth of the Snake River, fall precipitation amounts to near 75 per cent of the 1943-1952 average were the rule.

The below average precipitation regime established during the fall of water year 1955 continued throughout the winter months (December through February). Winter precipitation totals, in per cent of the 1943-1952 average, were: Western Montana, 60 per cent; Columbia Basin in Canada, 70 per cent; Cascade basins in Washington, 80 per cent; Snake River above American Falls, 80 per cent; Oregon and Idaho tributaries to Snake River between American Falls and the mouth of the Grande Ronde River, 60 per cent; Grande Ronde, Clearwater and Spokane basins, 65 per cent; and Central Oregon basins, 50 per cent of average.

It is interesting to note that the mean monthly 700 mb. chart for January 1955 shows rather markedly the flow pattern which persisted throughout the month of January and a large percentage of the fall and winter months, resulting in the below average precipitation. A ridge of high pressure over the Columbia Basin tended to block off incoming storms, shunting them to the north in most cases. A condition favoring average or above average precipitation amounts would be more like January of 1953 when the entire Basin was in the path of strong southwest flow--with storm tracks centered directly over the Basin.

March precipitation ranged from well above the 10-year (1943-1952) average in Western Montana and East Slope Cascades in Washington to as little as 50 per cent of average in the Owyhee Basin in Oregon. In general, above average March precipitation was recorded in the Upper Columbia and extreme Lower Snake Basins; below average precipitation was the general rule in the Snake Basin in Idaho above Weiser. More than 150 per cent of average March precipitation was observed at numerous stations in Western Montana, Columbia and West Kootenay basins in Canada and East Slope Cascades in Washington, Northern Oregon and Southern British Columbia. Several stations in Upper Clark Fork in Montana and East Slope Cascade basins in Washington recorded more than twice their average March precipitation. In the Northeastern Oregon Snake tributaries, North Fork Clearwater, Snake drainage in Wyoming and the Flathead-Kootenai-Lower Clark Fork basins in Montana, March precipitation was near 120 per cent of average. Generally

below average March precipitation was recorded in the remaining areas of the Columbia Basin: East Kootenay in Canada, 85 per cent; Spokane Basin, 85 per cent; Pend Oreille in Washington and Idaho, 70 per cent; John Day, 60 per cent; Henry's Fork, 85 per cent; Snake Plain between American Falls and Murphy, Idaho, 60 per cent; Owyhee Basin, 50 per cent, and Snake Basin in Idaho between Murphy and Lewiston, 75 per cent of average.

April precipitation amounts for various stations in the Columbia Basin, from April 1st to 0430, April 13th, in percentage of the 10-year (1943-1952) average, are as follows:

Revelstoke	71%	Pocatello	67%
Old Glory	63	Boise	57
Mullan Pass	61	Meacham	56
Missoula	45	The Dalles	47
Helena	61	Stampede Pass	75
Grangeville	59	Seattle	98

Preliminary Streamflow, Lake Level and Meteorological Data for Columbia River Basin in Canada from 1 October 1954 to 31 March 1955, by W. C. Warren, District Engineer, Department of Northern Affairs and National Resources Engineering and Water Resources Branch, Water Resources Division, Vancouver, B.C.

1. During the past six-month period, precipitation was below normal throughout the Columbia River Basin, ranging from 5% below in the Revelstoke area to 35% below in the Cranbrook area. In the Okanagan area precipitation was well below normal.

2. Temperatures during the period as a whole averaged about normal, with below normal temperatures in March and the last half of February and above normal temperatures during the remainder of the time.

3. Run-off during the period was above normal in the Columbia River Basin and well above normal in the Okanagan area.

4. Attached hereto are tabulation sheets giving preliminary water and weather data in the basin for this period.

PRELIMINARY STREAM FLOW DATA IN COLUMBIA RIVER BASIN IN CANADA
1 October 1954 to 31 March 1955

Typical Station	Run-off % of Normal 1 Oct 54 to 31 Mar 55	Run-off % of Normal 1 Oct 53 to 31 Mar 54	Normal Run-off 1,000 acre-feet 1 Oct to 31 Mar	Maximum Daily Q Sec.-ft./sq. mile	Date of Occurrence	Recorded Maximum Daily Q Sec.-ft./sq. mile	Date of Occurrence	Minimum Daily Q. Sec.-ft./sq. mi.	Date of Occurrence	Recorded Minimum Daily Q Sec.-ft./sq. mi.	Date of Occurrence
Columbia River near Revelstoke (Twelve Mile Ferry)	122	122	3,107	2.16	12 Oct 54	7.65	21 Oct 40	0.37	28 Mar 55	0.19	31 Jan 44
Columbia River at Birchbank	116	112	9,395	1.64	2 Oct 54	2.56	1 Oct 27	0.49	30 Mar 55	0.26	3 Feb 37
Kootenay River at Wardner	111	97	831.4	0.93	1 Oct 54	2.57	18 Oct 26	0.25	25 Mar 55	0.12	Jan & Mar 14
Okanagan River at Penticton	139	114	195.0	0.44	14 Oct 54	0.41	1 & 2 Oct 28	0.09	25 Oct 54	Nil	Dec. 31 & Jan 32 & Jan 54

Note: Normal run-off is based on the 10-year period 1942 to 1951 inclusive.

PRELIMINARY METEOROLOGICAL AND LAKE LEVEL DATA IN COLUMBIA RIVER BASIN IN CANADA
1 October 1954 to 31 March 1955

Location	Precipitation % of Normal 1 Oct 54 to 31 Mar 55	Normal Precipitation Inches 1 Oct to 31 Mar	Mean Temperature % of Normal 1 Oct 54 to 31 Mar 55	Normal Temperature °F. 1 Oct to 31 Mar
Cranbrook	65	8.56	102	26
Golden	67	9.90	103	25
Revelstoke	95	28.77	96	32
Nelson	77	16.85	98	34
Penticton	53	6.20	101	35

Location	Elevation 31 Mar 55 Feet	Normal Elevation 31 Mar Feet
Kootenay Lake at Queens Bay	1739.75	1738.95
Upper Arrow Lake at Nakusp	1376.00	1376.16
Lower Arrow Lake at Needles	1369.55	1369.61
Okanagan Lake at Penticton	1120.78	1120.72

Note: Normals are based on the 10-year period, 1942 to 1951 inclusive.
Elevations are above mean sea level (G.S.C. Datum, Pub. 24, 1951 Edition).

Summary of Streamflow Conditions in the Columbia River Basin Since October 1, 1954, by Hollis M. Orem, U. S. Geological Survey, Current Records Center, Portland, Oregon. 1/

Note: Issues of the Pacific Northwest Water Resources Summary for March, 1955, and the April 7, 1955, release of monthly mean discharge will be passed out for reference.

The Effects of Changing Standard

It has been the custom to use the average of a 10-year moving period with a two year lag as a standard for forecasts in the Pacific Northwest. The period used last year was 1942-51 and would have been 1943-52 this year. On August 17, 1954, the Subcommittee on Water Management, CBIAC, adopted a report on "Recommended Base Period for Comparing Runoff Forecasts and Related Hydrologic Data in the Columbia River Basin." That report, recommending use of the mean flow in the 15-year period (water years 1938-52) for the forecast years 1955 through 1959, was adopted by the Columbia Basin Inter-Agency Committee on November 10, 1954. Later, the Weather Bureau decided to continue the 10-year period 1943-52 for 1955 to allow time for all sections of the country to change over to the new 15-year period, and the Soil Conservation Service followed suit. If the record of the Columbia River near The Dalles can be considered typical, standards of runoff could be compared as follows:

		Annual	6 months Oct.-Mar.
Mean observed flow for period of record 1878-1954	cfs	195,100	
Mean flow in 15 years 1938-52, adjusted for storage	cfs	182,700	98,000
Mean flow in 10-years 1943-52, adjusted for storage	cfs	192,800	100,700

Thus, the average annual streamflow of the 15-year period is about 5 percent less than that of the 10-year period. For the average flow in the first 6 months, the difference is about 2 percent. I have used the 15-year average.

Review of Antecedent Period

A summary of streamflow for the October-March period for this year would not be complete without a brief review of the unusual preceding conditions. You will recall that in March 1954 the snow surveys indicated near-record snow pack and very high flows were expected to follow in April, May, and June as the snow melted. However, we had a protracted period of cool weather in April and the first part of May. The period of really warm weather caused seasonal peak flows about May 20 on most streams in the northwestern United States. In May 1954 the 1948 peak flows were approached or exceeded at a number of stations in the Kootenai, Flathead, and Clark Fork

1/ Publication authorized by the Director, U. S. Geological Survey.

basins, but these high flows were checked by a period of cool weather lasting from May 21 through most of June and were largely expended before the high flows on the main stem of the upper Columbia River, which continued to rise till mid-June.

The large portion of the great snow pack still remaining at the end of June 1954 came off gradually. July, August, and September flows flows ranked very high among those recorded for the various streams. Thus we entered the present subject period of October to March of this year with very high base flows.

Gradual decay October to March of this year.

Comparatively high flows continued from October through December, particularly in the Columbia River basin above the Snake River, although there was a tendency for the monthly mean flows to drop in rank among the recorded flows for the respective months. By November, mean flows in the Snake River Basin and the Columbia River Basin below the Snake began to drop below median in their period of record, and most of these streamflows had low rank for December.

During the last three months, January to March, the water situation has deteriorated greatly. January flows in the Columbia basin above the Snake River ranked high among those recorded for the month, although the Spokane, Yakima, and upper Clark Fork had dropped below median among the flows of record. By February only a few of the streams in the north had mean flows above median rank among those recorded; and most of those in the south had flows of very low rank. One, the Grande Ronde River at La Grande, had the lowest mean flow in 45 years of record. March flows were even lower; about 27 of those stations on the current reporting list had flows within the lowest 7 or 8 per cent of record for the month. According to preliminary computations of mean flow, about 12 of these set new record low flows, as shown in the PNW Water Resources Summary for March 1955, which has been distributed to you.

This gradual deterioration of streamflows is illustrated by Plate 1, which shows the percentage of previous flows exceeded by those of the past year at representative gaging stations for the respective months. This decline should be given consideration when comparing total flows for the six-month period. The streamflow graphs in the PNW Water Resources Summary for March indicate this decline in the last six months.

October to March Flows Compared with the Average in 1938-52.

The release of April 7, 1955, shows the total runoff for the first six months of this year and a comparison with mean flows in the 15-year base period (water years 1938-52). Percentages of average runoff in Montana ranged around 85 per cent for the upper Clark Fork and from 99 to 109 per cent for the Kootenay and Flathead River basins.

Runoff of the Columbia River at international boundary, adjusted for storage changes upstream, was 108 per cent of that in the 1938-52 period. The relatively high runoff from British Columbia compensated for near average runoff in Montana and northern Idaho.

Low incremental runoff between the international boundary and Grand Coulee Dam lowered the adjusted runoff at Grand Coulee to 102 per cent of average. Low percentages such as 70 for St. Joe River at Calder, 47 for Coeur d'Alene River at Enaville, and 60 per cent for Spokane River at Spokane more than counterbalance the high runoff for the Kettle River, which is a smaller stream than the Spokane River.

Runoff of the Kettle, Similkameen, Okanogan, and Methow Rivers was 166, 150, 139, and 133 per cent, respectively. While these percentages were high, the above-average runoff from these streams and from the Chelan River was not enough to raise the adjusted flow for the Columbia River at Trinidad above 102 per cent of average, the same as at Grand Coulee.

Adjusted runoff of the Chelan River was 114 and the observed runoff of the Wenatchee River was 106 per cent of average. These above-average flows were more than balanced by the 80 per cent observed runoff of the Yakima River. The preliminary figures indicate that the total runoff of the Columbia River above the mouth of the Snake River was just above 100 per cent of average in the 1938-52 period.

Adjusted runoff for the Snake River at Heise and Milner was 92 and 97 per cent of average respectively, but flows in the lower part of the Snake Basin were much less. Adjusted runoff for the Boise River at the diversion dam was 61 per cent and that for Payette River at Horseshoe Bend 66 per cent of average. The Salmon River at Whitebird and the Clearwater River at Spalding were 78 and 47 per cent of average, respectively; but the really low rivers were the Grande Ronde at La Grande and Weiser River near Weiser, with 14 and 26 per cent runoff. Low runoff in the lower tributaries resulted in a 69 per cent runoff for the Snake River near Clarkston.

The Umatilla River near Umatilla and John Day River at Service Creek were also very low at 24 and 27 per cent of average, but the more stable Deschutes River at Moody was 86 per cent of average. Observed runoff of the Columbia River near The Dalles was 104 per cent of average, but storage release from the 7 major power reservoirs was much greater than usual and the adjusted flow was only 87 per cent of average in the 15-year period 1938-52.

October to March Flows Compared with the Average in 1938-52 - Continued

To summarize, the relatively high runoff from British Columbia and slightly sub-average flows from Montana resulted in a higher-than-average runoff at the international boundary. Low flow in the Spokane River

more than balanced the high flows in central Washington tributaries to bring the runoff above the Snake River near the 15-year average. Low flows in the Snake River and lower tributaries reduced the adjusted runoff near The Dalles to well below average.

Comparison with Last Year

The Kootenay, upper Columbia, and Flathead River flows were a little above last year. The net result at Grand Coulee was to bring this year's adjusted flows to about the same as last year's. The Okanogan and Methow were higher this year, but the Yakima was lower. The Snake River runoff was about the same at the upper end, but flows were only 94 per cent of last year at Weiser and 78 per cent at Clarkston. The Umatilla and John Day were about 30 to 35 per cent of last year, and the Deschutes about 92 per cent. Adjusted runoff of the Columbia River near The Dalles was about 90 per cent of that last year.

Status of Ground Water Storage in the Columbia River Basin in 1955, by J. W. Stewart, U. S. Geological Survey, Boise, Idaho.

The status of ground-water storage is inferred from water levels in a network of representative wells that are measured by the United States Geological Survey. Most of the wells are privately owned and are situated in major valleys and ground-water basins. Table I is a summary of data for 22 such wells for which records of periodic measurements cover intervals of 7 to 28 years. The average length of record is 18 years.

A larger number of wells would be needed to represent adequately the status of ground-water storage in an area as large and geologically diverse as the Columbia River Basin. Lowland, plateau, and valley areas are covered in general, but some important basins are not represented. The Montana part of the Columbia River basin is not represented in this report.

The wells reported represent the status of storage in lowland areas. Taking the highest water level of record as 100 and the lowest as o, the water level at any time is expressed as a percentage of the total range and is called the storage index. A level midway between the highest and lowest levels is arbitrarily called the midpoint or 50-percent level. Water-level changes, other than minor fluctuations, represent changes in ground-water storage, and the levels on a given date in successive years indicate net changes in storage. April 1 is the date for the index values reported herein.

Upper Columbia River Basin in Idaho and Washington

In the Rathdrum Prairie part of the Spokane Basin in Idaho, ground-water levels in wells near Pend Oreille Lake were above the midpoint; in wells southeast of the lake the average is about at the midpoint. In wells near the lake water levels were about 10 feet above those in April 1954, whereas in wells distant from the lake water levels were about 2 feet below those of the povious years. In the Spokane Valley in Washington the water levels were below the midpoint in three wells and storage indexes ranged from about 16 per cent above to 29 per cent below those for 1954. Ground-water discharge is the principal source of the dry-season increments of flow in the Spokane and Little Spokane Rivers in Eastern Washington. Ground-water contributions to the Spokane River and its tributaries in 1955 probably will be about equal to or somewhat smaller than those in 1954. The ground-water reservoir has more than its average unoccupied storage space to accept late spring and summer recharge.

The storage index for one well in the Columbia Basin Project area of Washington was considerably above the mid-point despite a slight net decrease since last year.

In the Okanogan Valley of Washington the storage index was 5.5 per cent, or about 8 per cent less than in 1954. Ground-water contributions to streams probably will be nearly equal those in 1954 and considerable recharge capacity is available in the aquifers.

Columbia River Basin in Oregon

In the Walla Walla Basin near Milton-Freewater, Oregon, the storage index for a single well was the same as in 1954. Ground-water discharge to streams in this basin in 1955 probably will be about the same as in 1954.

The storage index for a single well in the Grande Ronde River Basin was 84.1 per cent, or slightly smaller than in 1954. In the Powder River Basin the index was 65.2 per cent, or about 25 per cent lower than in 1954. Ground-water contributions to surface streams in these basins probably will be comparable or slightly smaller than in 1954.

Water levels in wells west of the Cascades, at Portland and Junction City in the Willamette Valley, were slightly below the cumulative month-end averages but were well within the range of normal fluctuation. Water levels in wells East of the Cascades near areas of stream recharge to the regional water table were below average; water levels in wells distant from stream recharge were well above average.

Snake River and Tributary Basins in Idaho and Washington

In the Almo Basin, a subdivision of the Raft River Basin, Idaho, the storage index for a single well was at a record low. Ground-water discharge in the Basin probably will be less than in 1954. Water levels in most wells are considerably below the April 1954 levels.

Storage indexes for wells in the Snake River plain East of Bliss, Idaho, range from 29 to 74 per cent. Indexes for three wells were 4 to 40 per cent less than in 1954, and in one well slightly greater than the 1954 level. In general, indexes for three wells were substantially below the midpoint and in one well considerably above the midpoint. The water levels in these wells reflect storage in the aquifer that feeds the springs in the Snake River Valley above King Hill. The contributions from these springs to the flow of the Snake River in the spring and summer of 1955 probably will be about the same as in 1954.

In the Boise Valley of Ada and Canyon counties storage indexes for two wells were slightly above the midpoint and in one well substantially below it. Owing to a gradual increase in ground-water storage, derived from excess irrigation water, the net trend in ground-water levels has been steadily upward during a period of more than 40 years. Although precipitation was below normal in 1954 and considerably less than in 1953, the water levels in several wells in the valley reached new highs in August and September. The continued rise in water levels probably was caused partly by

increased application of irrigation water during an abnormally dry spring and summer. Ground-water discharge to surface streams in 1955 will be about the same as in recent years.

In a single well in a mountain tributary valley of the Payette Basin, Idaho, the index is substantially below the midpoint and about 15 per cent less than in 1954. Precipitation in the area in 1954 was below normal. Ground-water contributions to streams probably will be comparable or slightly less than in 1954.

In the Palouse Valley of the Lower Snake River Basin storage indexes were well above the midpoint. The index for one well was about 25 per cent less than in 1954, and in another well about 10 per cent greater than in 1954. Ground-water discharge from the area in 1955 probably will be about as much as in 1954.

Conclusions

In 1954 the unweighted average storage index of 23 wells was 54.6 per cent and the range was from 10.5 to 100 per cent. In 1955 the unweighted average storage index of 22 wells was 46.5 per cent, and the range was from 0 to 97 per cent. In 1955 approximately one-fifth of the ground-water levels were in the high middle range, in contrast to 1954 when about one-third the levels were in this range. Approximately two-thirds of the storage indexes were either slightly above or slightly below the midpoint. Adequate storage space is available to accept recharge and help alleviate flood discharge in surface streams. Except for areas in which the indexes are substantially below the midpoint, most ground-water reservoirs contain sufficient reserve to contribute about the normal amount of water during the low-flow stages of streams, but the reserve is somewhat less than in 1954.

Table I. Storage Indexes for Selected Wells in Columbia River Basin, 1953-55

Well Number 1/	Location	Length of Record (Years)	Index, in Per Cent of Total Observed Range, April 1 1953	1954	1955
Upper Columbia River Basin					
53N-4W-24bbl	Rathdrum Prairie, nr. Athol, Idaho	27	79.0	66.2	64.9
51N-5W-33bbl	Rathdrum Prairie, nr. Post Falls, Idaho	28	78.5	55.8	48.8
50N-5W- laal	Rathdrum Prairie, nr. Post Falls, Idaho	27	72.7	62.1	53.6
25/42-14L1	Spokane Valley at Riverside Cemetery, nr. Spokane, Wash.	15	37.0	40.8	19.5
25/45-16C1	Spokane Valley nr. Greenacres, Wash.	27	79.1	62.8	33.8
26/43-19A1	Spokane Valley North of Spokane, Wash.	25	33.3	10.5	26.8
22/27-30P1	Grand Orchard, Columbia Basin Project, Washington	16	89.7	100.0	95.6
40/27/28G1	Okanogan Valley at Oreville, Wash.	16	4.6	13.4	5.5
6N/35-36H1	Walla Walla Basin nr. Milton, Ore.	20	48.8	11.6	11.6
1/39-17L1	Grande Ronde River Basin nr. Imbler, Oregon	15	91.5	93.6	84.1
8/39-22F1	Powder River Basin nr. Haines, Ore.	17	95.8	91.4	65.2
Snake River and Tributary Basin					
15S-25E-6abl	Almo Basin nr. Almo, Idaho	8	9.1	18.8	0
3N-29E-14adl	Snake River Plain, SE Butte Co., Ida.	7	92.6	64.7	29.4
8S-24E-11bal	Snake River Plain, S. Minidoka Co., Ida.	8	73.4	73.3	33.3
10S-20E-5bal	Snake River Plain, Se Jerome Co., Ida.	8	78.5	78.5	74.2
5S-15E-35dcl	Snake River Plain, Nr. Gooding, Ida.	7	48.7	31.8	43.6
3N-1E-5aal	Boise Valley nr. Boise, Idaho	23	35.6	29.4	27.0
3N-1W-1ccl	Boise Valley nr. Meridian, Idaho	25	60.7	58.5	61.5
3N-2W-25aal	Boise Valley nr. Nampa, Idaho	26	58.0	55.1	57.4
7N-2E-34cal	Payette River Basin nr. HorseshoeBend, Idaho	12	81.5	43.5	29.6
14/45-11N1	Palouse River Basin, nr. Pullman, Wash.	19	83.9	86.8	97.0
14/46-20K1	Palouse River nr. Pullman, Wash.	19	82.3	85.5	60.3

1/ Well numbers are based on the rectangular system of subdivision of public lands. The two parts of the first segment of the numbers indicate the township and range (Willamette base and meridian in Washington and Oregon; Boise base and Meridian in Idaho). The second segment indicates the section by number, and the 40-acre tract within the section by a code system. The numbering systems are fully described in U.S. Geological Survey Water-Supply Papers 990, p. 157, 1946, and 1100, p. 34, 1947.

RUNOFF AND PEAK FORECASTS

Snow Cover and Runoff Forecasts, Columbia River Basin for 1955, British Columbia, by Jack Doughty-Davies, Water Rights Branch, Department of Lands and Forests, Victoria, B.C.

Most snow courses in the Columbia, Kootenay, Similkameen, and Skagit river basins in British Columbia have snow water contents which are near normal. Our observers in these areas report the ground damp under the snow with perhaps the exception of the most northerly courses. Thawing appears to have started over most of the southern areas.

The April to September runoffs in these areas are predicted to be near normal. Unless exceptionally high temperatures occur, the runoff should not produce damaging floods.

Snow packs in the Okanagan are also near normal but due to the large influence of spring precipitation the comparison of the forecast runoff appears 25% below normal. Water users in this area should anticipate normal water supplies.

Forecasts for the Columbia River Basin

Forecast Committee

STATION	FORECAST 1955 Apr.-Sept. in 1000's Ac. Ft.	PER CENT 1943-52 NORMAL
Columbia at Nicholson	2,370	108
Columbia at Birchbank	39,600	99
Columbia at Revelstoke	16,950	96
Kootenay at Wardner	3,958	93
Elk at Stanley Park	1,375	109
Lardeau at Gerrard	631	114
Duncan at Howser	1,990	95
Slocan at Crescent Valley	1,785	102
Inflow to Kootenay Lake	16,210	98
Inflow to Okanagan Lake	260	74

Water Supply Outlook for 1955 Season, April 1, 1955, by Ashton R. Codd, Hydraulic Engineer, Soil Conservation Service, Bozeman, Montana

A fair water supply outlook now exists over the Missouri and Columbia River Basins in Montana. The several good storms which covered the State during March produced sufficient moisture to raise the potential water supply to almost normal in many basins and slightly below in others.

The terrific snow storm from April 1 through April 6 brought a record high snowfall to many sections of the State and left others completely bare. This spotted condition of the storm has made it difficult to evaluate in the terms of seasonal or early runoff. No doubt there will be local flooding in some areas, but the general condition from a seasonal runoff standpoint is not serious. There is no doubt that the storm will be of immense value to the dry-land farmers throughout the eastern part of the State where precipitation has been lacking during the fall and previous winter months.

Reservoir storage in the northern part of the State is above average, while on April 1 reservoir storage in the southern and central part of the State was somewhat below average.

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For further details and forecasts, see "Federal-State Cooperative Snow Surveys and Water Supply Forecasts, Montana and Northern Wyoming, Upper Missouri, Upper Columbia and Yellowstone Rivers," prepared by A. R. Codd, Hydraulic Engineer, Soil Conservation Service, and O. W. Monson, Irrigation Engineer, Montana Agricultural Experiment Station, Bozeman, Montana, for April 1, 1955. The report was issued by Truman C. Anderson, State Conservationist of Montana, and M. M. Kelso, Director, Montana Agricultural Experiment Station, Montana State College, Bozeman, Montana.

Washington -- Walter Johnson, Washington Water Power Company, Spokane, Washington

The Company makes annual snow surveys in the Coeur d'Alene Lake Basin in northern Idaho, which is the source of the Spokane River and in the Lake Chelan Basin located on the east slopes of the Cascade Mountains in northcentral Washington.

Very briefly our 1955 results are:

Spokane River

The average water content of nine snow courses as of March 15 was 22.4 inches. It is 89 per cent of the (1943-1952) 10-year average.

We forecast the runoff at Post Falls for the period, March 16 to September 30, to be 3,000,000 acre feet, or 87 per cent of the 10-year normal. Spokane River will probably peak at 26,000 cfs. next month.

Lake Chelan

The average water content of 18 snow courses as of April 1 was 32.1 inches or 90 per cent of the 10-year average.

Our forecast of total Lake Chelan inflow for the filling period, April through July, is 1,070,000 acre feet, which is 96 per cent of the 10-year average. With this supply, the Chelan Plant can be operated at the maximum allowed limit, and we will waste 147,000 acre feet, which is equivalent to $4\frac{1}{2}$ feet of lake storage during June and July.

Six weeks ago it appeared that we were going to have a low water year, but now it appears to be a one hundred per cent of normal year.

* * * * *

Washington - W. R. Bowlin, Engineer, Surface Water Branch, U. S. Geological Survey, Federal Building, Tacoma, Washington

Snow courses measured by the Tacoma District of the U. S. Geological Survey are 32 in number and range from 1,900 feet to 6,500 feet in elevation. They are located along and westward of the Cascade Range in the major coastal river basins including the Olympic Peninsula.

Heavy storms in western Washington during March reduced the deficiency indicated on the March 1st snow surveys. By April 1st the snow pack was found to be practically normal.

The only real deficiency is in the Olympics where the Skokomish River Basin snow courses measured 20 per below average.

The results obtained are as follows:

River Basin	Per cent of Average	No. of Courses	Years record
Skagit - above 3,500 ft. elevation	84	4	6-12
below 3,500 ft. elevation	103	4	5-12
Cedar	105	2	8-10
White	93	3	15-16
Nisqually - above 4,500 ft. elevation	96	3	6
at 2,760 ft. elevation	135	1	6
Cowlitz	94	3	5-15
Lewis - White Salmon	93	3	11-12
Skokomish	81	3	5-6

The snow pack in general was composed of coarse heavy crystals and was unusually homogeneous for that time of year. No ice layers were encountered except in the Cedar River basin.

The general snow line was at about 1,000 ft. in the Skagit area, about 1,500 ft. in the Olympics, and approximately 2,000 ft. in the central and southern sections of the state.

To summarize the snow-cover picture in western Washington, we have a slightly below average snow cover in the northern and southern portions, average in the central portion and about 20 per cent below average in the Olympics.

* * * * *

Washington -- Water Supply Outlook, State of Washington, April 1, 1955, by Robert T. Davis, Hydraulic Engineer, Soil Conservation Service, Spokane, Washington.

The water supply outlook for irrigation and power in the Upper Columbia Basin of Washington and Canada is slightly below normal. Snow surveys made about the first of April indicate a snow pack that is 91 per cent of normal for the State of Washington East of the Cascade Range and 90 per cent of normal on the West Coast and Olympic Peninsula. This is an increase of 18 per cent since the first of March. Most snow courses were reported to have dry soil under the snow due to the lack of fall precipitation and the fact that the spring melt has not yet started. The irrigation reservoirs are all slightly above the 1943-52 average while power reservoirs are considerably below.

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For further details and forecasts, see "Federal-State Cooperative Snow Surveys and Water Supply Forecasts for Washington," prepared by Robert T. Davis, Hydraulic Engineer, Soil Conservation Service, Spokane, issued April 9, 1955, by Paul C. McGrew, State Conservationist, Soil Conservation Service, U. S. Department of Agriculture, and Murray G. Walker, Supervisor, Division of Water Resources, Department of Conservation and Development, State of Washington.

Water Supply Outlook for Oregon, April 1, 1955, Report prepared by W. T. Frost, Hydraulic Engineer, and Manes Barton, Assistant Water Forecaster, Soil Conservation Service, Portland, Oregon

Most Oregon Water users can expect only a "fair" to "poor" water supply this year even though storms during the latter part of March markedly increased the mountain snow-pack. Heavy spring rains would improve this outlook.

SNOW-COVER: March storms produced about 25 per cent more snowfall than usual bringing April 1 snow-cover up to 90 per cent of normal. Water content of snow is below 80 per cent average in the Owyhee, Pine, Imnaha, Wallowa, Rogue (except Illinois), Klamath (except Gerber-Clear Lake), and Interior (except Harney Basin) watersheds.

SOIL MOISTURE: Mountain soils are very dry under the snow-pack, particularly in eastern and southern Oregon. These dry soils will take up much of the early snow-melt water. Soils at median elevations are now better wetted due to heavy snowfall during the latter part of March and its subsequent melting.

RESERVOIRED WATER: Stored water is quite short with 14 out of 26 reporting reservoirs less than half full. Total storage is about one-half of the ten year (1943-52) average and two-thirds of that of one year ago. Reservoirs with particularly low storage are Antelope, Owyhee, Warmsprings Agency Valley, Unity, McKay, Detroit, Emigrant Gap, Cottonwood and Drew.

Stored water in many areas will augment streamflow sufficiently to insure at least fairly adequate irrigation water supplies for this year.

PRECIPITATION: Valley winter precipitation was two-thirds normal this year with the Upper Deschutes area receiving the low of only one-third normal. The highest area was the Willamette Valley with three-fourths normal winter precipitation. March precipitation was about 80 per cent normal. Fall precipitation was only half normal.

STREAMFLOW: Below average streamflow is forecast throughout Oregon except for the Umatilla Basin and certain streams in the Willamette Valley. Short water supplies are foreseen in the following watersheds: Owyhee, Malheur, Burnt, Powder, Pine, Imnaha, Grande Ronde, John Day, Crooked, Rogue (except for Upper Roque), Sprague, and Interior drainages. Stored water in these basins is expected to improve the situation for those water users served from reservoirs.

March streamflow was extremely low this year with four reporting streams experiencing the lowest March flows on record. These were the Grande Ronde at LaGrande, South Fork Walla Walla near Milton, Umatilla near Umatilla and John Day at Service Creek.

For further details and forecasts, see "Federal-State Cooperative Snow Surveys and Water Supply Forecasts for Oregon," issued April 9, 1955, Report prepared by W. T. Frost, Hydraulic Engineer and Manes Barton, Assistant Water Forecaster of the Soil Conservation Service and Oregon Agricultural Experiment Station, 209 SW 5th Avenue, Portland 4, Oregon. The report was issued by Harold E. Tower, State Conservationist, Soil Conservation Service and F. Earl Price, Director, Oregon Agricultural Experiment Station.

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Water Supply Outlook for Nevada, by Norman S. Hall, Hydraulic Engineer, Soil Conservation Service, Reno, Nevada

The water supply outlook for Nevada during the 1955 runoff season is poor. The only near normal area is in eastern Nevada in White Pine County which has about 90 per cent snow stored water as of April 1. Along the Humboldt tributaries, streams are expected to flow from 40 to 50 per cent while the main Humboldt at Palisade is forecast to flow 17 per cent of normal. Ground water levels in this area are all at new record lows. Runoff into Nevada from the east-central Sierra will range from 50 to 70 per cent of normal.

The remaining portion of Nevada has about a 70 per cent of normal snow pack as of the first of April.

April 1 reservoir storage in seven important reservoirs was only 44 per cent of capacity and 67 per cent of the 1943-52 ten year average.

The snow pack on the Columbia Basin tributaries is very poor. It is forecast the Owyhee River near Gold Creek, Nevada, will flow 11,000 acre feet or 39 per cent of the ten year average. The Owyhee at Owyhee, Nevada will flow 45,000 acre feet or 46 per cent of normal.

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For further details and forecasts, see "Federal-State Cooperative Snow Surveys and Water Supply Forecasts for Nevada," prepared by Norman S. Hall, Hydraulic Engineer, Soil Conservation Service, 1485 Wells Avenue, Reno, Nevada. This report was issued by George Hardman, State Conservationist, Soil Conservation Service, and Hugh A. Shamberger, Nevada State Engineer, April 9, 1955.

Water Supply outlook for Idaho and the Columbia Basin, by Morlan W. Nelson, Snow Survey Leader for the Columbia Basin, Soil Conservation Service, Boise, Idaho

The water supply outlook for Columbia Basin is for slightly below normal streamflow in the northern and eastern portions in Canada and the states of Washington, Montana, northern Idaho and Wyoming. The southern half of the Basin in southern Idaho and eastern Oregon has a poor water supply outlook with the exception of the main stem of the Snake River. Snowfall during the month of March was above normal throughout the Columbia Basin. Significant increases in the snow pack occurred on the watersheds of all northern rivers, but very little change took place in the southern portion of the Basin where the water is needed the most. A small portion of the low altitude snow pack has melted, but generally low March temperatures and absorbent, dry soils beneath the snow resulted in unusually low streamflow. Reservoir storage in general is good except for the Owyhee and several small reservoirs in southern Idaho.

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For further details and forecasts, see "Federal-State Cooperative Snow Surveys and Water Supply Forecasts for Columbia Basin," report prepared by Morlan W. Nelson, Snow Survey Leader, Soil Conservation Service, Snow Survey Section, Box 835, Boise, Idaho, April 1, 1955. This report was issued by R. N. Irving, State Conservationist, Soil Conservation Service, Boise, Idaho.

FORECASTS OF RUNOFF AND PEAK STAGE

Forecasts of Runoff and Peak Flow for the Columbia River at The Dalles by D. W. Kuehl, U. S. Weather Bureau, Portland, Oregon.

First, I would like to present briefly the selected Weather Bureau water year runoff forecasts which appear on the wall map. The numbers in red are the Weather Bureau's forecasts expressed in per cent of the 1943-1952 average.

It is well established that most of the variance of the peak discharge in spring snow-melt rises is explained by the size of the April-September flow volume. Therefore, before I present our peak flow forecasts for 1955, I would like to give the key April-September volume forecasts upon which they were based. These forecasts are in terms of observed flow, corrected for the usual reservoirs.

Station	Acre Feet	(1943-1952) %
Kootenai River at Leonia	7,150,000	84
Pend Oreille River at Z-Canyon	11,700,000	71
Columbia River at Birchbank	37,300,000	91
Spokane River at Post Falls	2,400,000	77
Columbia River at Trinidad	60,000,000	84
Snake River at Weiser	4,220,000	53
Salmon River at Whitebird	4,460,000	64
Clearwater River at Spalding	7,180,000	80
Snake River at Clarkston	18,000,000	66
Columbia River at The Dalles	82,000,000	80

As of April 1st, there is an unusually low flood potential in the Columbia Basin. The coordinated Weather Bureau-Soil Conservation Service prediction of the most probable value of the observed peak discharge at The Dalles is 450,000 cfs. This flow would result in peak stages of near 17 feet in the Portland and Vancouver harbors. This is of course based on the assumption of normal weather conditions during the melt period.

Observed peak discharges on the Snake River at Clarkston and on the Columbia River at Trinidad are expected to be 150,000 cfs. and 320,000 cfs., respectively. Peak stage on the Kootenai River at Bonners Ferry, Idaho, assuming near average temperature and precipitation conditions during the melt season, is predicted to be 30 feet. (Flood stage at Bonners Ferry is 31 feet). Adverse weather conditions during the melt period could cause these peak flow estimates to be low.

Mr. Oliver Johnson of the Corps of Engineers, Portland, Oregon, made the following forecasts of volume and peak discharge:

CORPS OF ENGINEERS, U. S. ARMY
FORECASTS OF VOLUME OF RUNOFF AND PEAK FLOW AT
SELECTED STATIONS
AS OF 1 APRIL 1955

		Forecasts in 1,000,000 Acre-Feet or 1,000 cfs.					
		Portland District		Walla Walla District		Corps Forecast 1/	
Stream	Station	Volume	Peak	Volume	Peak	Volume	Peak
Columbia	Birchbank	40	230	39.5	220	40	225
Columbia	Trinidad	58	325	64.5	310	61	320
Columbia	The Dalles	81	500	80	440	80	470
Kootenai	Leonia	8.5	82			8.5	82
S. Fk. Flathead	Hungry Horse	-				1.9 2/	-
Pend Oreille	Metaline Falls	11.5	75	14.4	74	13	75
Okanogan	Tonasket	1.5	16	1.1	11	1.3	13
Spokane	Spokane	2.6	26	2.6	21	2.6	24
Yakima	Kiona	13	1.2	7		1.2	10
Snake	Moran			0.8	7	0.8	7
Snake	Heise	3.5	23	3.5	20	3.5	21
Snake	Weiser			4.8	33	4.8	33
Snake	Clarkston	20.0	170	21.2	160	20.6	165
Henry's Fork	Rexburg			0.7	5	0.7	5
Boise	Boise			1.0	-	1.0	-
Payette	Emmett			1.6	8	1.6	8
Salmon	Whitebird	5.0	54	4.9	48	5.0	51
Grande Ronde	Rondowa			1.0	10	1.0	10
Clearwater	Spalding	7.4	90	8.0	92	7.7	91
Deschutes	Moody	2.0	17			2.0	17

1/ Average of Portland and Walla Walla District forecasts modified in some cases by the North Pacific Division

2/ From the Seattle District by use of a procedure still under study.

GENERAL SUMMARY

General Summary of Run-off Situation, presented before Columbia River Basin Water Forecast Committee, April 13, 1955, by M. J. Ord, Corps of Engineers, Walla Walla District

We have been given a very comprehensive picture of the conditions affecting run-off this season and forecasts of the run-off. I have been asked to present a general summary of the situation. I feel that the material has been very well summarized in the presentations and therefore, I will be brief. I will ask Mr. Conway, my associate in Walla Walla, to place a summary of run-off at key locations on the blackboard while I briefly summarize the material that has been presented.

In the discussion of 1954 run-off, Mr. Kidd and Mr. Simons have indicated the forecast for last year were, in general, very good. On the average, forecasts error were within 9 to 10 per cent, which is close considering the many variables which are involved. However, there is still room for improvement.

For this year, we have been shown that the precipitation has been generally below the 10-year normal during the fall and winter months with greatest departures from normal in the central Snake River Basin and in southeastern Oregon. March precipitation improved conditions with above normal amounts in the Upper Columbia and Upper Snake, but still with below normal amounts in the southwestern Idaho and southeastern Oregon. For April, so far, precipitation is indicated to be above normal for the month.

Temperatures have been below normal, generally during February and March causing delayed snow melt and low streamflows. Several record low streamflows for March were recorded.

Storage in reservoirs are generally below average for this time of year. However, except for those in southwestern Idaho and southeastern Oregon, all reservoirs are expected to fill.

Except for a few streams, run-off forecast show expected run-off for April-September to be 80 per cent or greater of normal for the Columbia Basin in British Columbia, Washington, northern Idaho and Montana. Southwestern Idaho and eastern Oregon is expected to be considerably below normal, with Owyhee Basin as low as 38 per cent and other small basins even less.

The Weather Bureau forecast a peak discharge of 450,000 cfs. for the Columbia River at The Dalles. The Corps of Engineers forecasts 470,000 cfs. (Reference was made to table place on blackboard by Mr. Conway, comparing forecasts of run-off by Weather Bureau, S. C. S. and Corps).

With regard to comparing precipitation and run-off to a 10-year average, I would like to show you this chart. (Chart was passed out which showed annual run-off at The Dalles plotted in 10-year running averages.

Also, included on the chart was 10-year running average of precipitation for Walla Walla). It is interesting to note that 10-year average of run-off for present time is close to the long period average. Also, that if we were comparing the run-off for this year with 10-year average during the period 1931 through 1947, the run-off situation would appear much more favorable.

Comparative Forecasts of Run-off and Flood Peaks

Stream	April-Sept. Run-off 1,000,000 acre-feet			Peak Discharge 1,000 cfs.		
	U.S.W.B.	S.C.S.	Corps	U.S.W.B.	S.C.S.	Corps
Columbia R. at Birchbank		38.5	40.0			225
Columbia R. at Trinidad	60.0	61.7	61.0	320		320
Columbia R. nr The Dalles	82.0	84.5	80.0	450		470
Snake R. at Clarkston	18.0	20.0	20.6	150		165
Salmon at Whitebird	4.5	4.9	5.0			51
Clearwater at Spalding	7.2	7.8	7.7			91